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SQUARING THE CIRCLE.

THE problem of squaring the circle, to which allusion is so often made—without, however, being always clearly understood—consists in constructing a square whose area shall be exactly equal to that of a given circle. Unhappily, the problem is insoluble; we can only arrive at an approximate solution; and in the present day no one who has even an elementary acquaintance with the first principles of geometry will lose his time in the vain attempt to solve it completely. True geometers have always been aware of the difficulty, or rather impossibility, of the task. In their investigations they have merely aimed at approximating nearer and nearer to exactness; and not unfrequently they have been, as it were, surprised into discoveries in the various branches of mathematical science. But there has always been a class of men less enlightened and more daring, who, scarcely knowing what they wanted or what they were doing, yet pretended to discover the squaring of the circle, perpetual motion, and other things beyond human power. The problem of squaring the circle is as old as geometry itself. It occupied the thoughts even of philosophers in Greece, the very cradle of mathematical science. Anaxagoras employed himself about it in the prison where he was confined for having proclaimed the doctrine that God is one and alone above all. Aristophanes, the Molière of the Athenians, introduces the celebrated philosopher Meton upon the stage, and cannot devise any better method of bringing ridicule upon him than by making him promise to square the circle. It was Archimedes who first found out the approximate ratio of the circumference of a circle to its diameter. Apollonius, or Philo of Gadara, found ratios still nearer the exact truth; but what they were is not

now known. The labours also of Adrian, Metius, Vietus, Zudolph, Van Keulen, Machin, and Lagny, in this direction of inquiry, are well known.

Cardinal de Cusa was the first of modern alchemist-geometricians. He fancied he had discovered the true method of squaring the circle, by making a circle or a cylinder roll along a plane surface until it had described its whole circumference; but he was proved by Regiomontanus to be in error. After him, towards the middle of the sixteenth century, a professor-royal of mathematics, Orontius Fineus, gained distinction by his remarkable fallacies on this subject. The celebrated Joseph Scaliger also indulged in these caprices. Thinking lightly of geometricians, he wished to show them the great superiority of a learned man like him. Vietus, Clavius, and others, having ventured to refute his mathematical reasoning, he became incensed, loaded them with abuse, and was more than ever convinced that geometricians had no common sense. About seventy years ago, M. Liger thought he had discovered the true solution, which had been for ages concealed from view, by demonstrating that the square root of 24 is equal to that of 25, and that that of 50 equals that of 49. His demonstration did not, he said, rest upon geometrical reasoning, which he detested, but upon the properties of figures.

There have been a number of bets and challenges in connexion with this problem at different times. The French Institute having been overwhelmed every year with voluminous packets on the squaring of the circle and perpetual motion, at length came to the resolution to receive no more upon these subjects. Yet only about a few years ago, on opening a paper which had been kept sealed for many years at the request of the author, as containing a precious discovery, it was found to be another attempt to solve the insoluble problem.

TUBULAR BRIDGE OVER THE WYE.

THE engineering achievements of modern times have been so singularly characterised for originality and boldness of conception and success in execution, that the word "impossible," as applied to anything which may be required, appears, if not to be repudiated, yet practically, to be ignored. The difficulties which presented themselves in the formation of that mighty and elaborate system of locomotion, which has been established in this and in other countries, seem to have challenged the dormant energies of our engineers only to be vanquished; and one after another noble structures have been reared, not simply to promote in a high degree the welfare of man, but to declare with silent yet impressive eloquence the dignity of the intellectual endowments which have been conferred upon him, for the dominion of the material creation, by the Father of all.

One of the most remarkable and interesting engineering works of modern times is the railway bridge crossing the Wye at Chepstow, which has just been completed. In the planning out of the South Wales Railway, which is to unite Gloucester with Milford Haven, and has already been opened as far west as Carmarthen, it was found necessary to cross the Wye, near Chepstow; and the problem to be solved was not an easy one. As it is a navigable river, the admiralty required that the space over the mid-channel should not be less than 300 feet, and that a clear headway of fifty feet above the highest known tide should be secured; so that across this "tidal chasm" an iron bridge had to be hung, capable of supporting the heaviest burdens that passing trains could impose. The work obviously demanded the highest efforts of mechanical and constructive skill, but the bold and experienced mind of the engineer was not overtasked by the exigencies of the case; and Mr. Brunel has produced a work which is believed to combine perfect efficiency with singular economy of material. In proceeding to describe this remarkable structure, as the two lines of railway are supported by separate though perfectly similar means, it will be necessary to make particular reference only to one.

The bridge, which Mr. Brunel has erected, consists of four spans, three of about 100 feet each, and one of 290 feet, extending altogether from bank to bank for 610 feet. The three smaller spans rest upon iron piers, filled with concrete, sustaining cast-iron girders, on which the railing is laid. The fourth and chief span, which is on the suspension principle, is supported by means of a tube more than 300 feet in length, and 9 in diameter. The tube itself rests on the summit of piers erected on the east bank and in the centre of the river, and to the ends of the tubes are attached the suspending chains. Now, in an ordinary suspension bridge, the chains hang in a festoon, and are free to move according to the weights passing under them, which are not in general great. This flexibility, however, would be altogether inadmissible in a railway bridge, for the continuity of the rails would be destroyed if a very small deflexion took place when traversed by a heavy locomotive. With a view to supply the necessary rigidity, Mr. Brunel has introduced at every third part of the tube a stiff wrought-iron girder, firmly connecting the tube with the roadway girders, and, with the aid of other adjusting screws, the suspension chains are stretched as nearly straight as is desirable. Other diagonal chains connect these points, so that at whatever part of the bridge a train may be passing, its weight is distributed over all the tube and chains by these arrangements.

In the operations connected with the sinking of the cylinders which form the piers of the bridge, some curious facts came to light. The workmen had first to pass through nearly thirty feet of blue clay and sand, below which they met with a thin bed of peat containing timber, some solid oak, hazel nuts, and other substances of the same kind. They next came to several feet of fine blue gravel, and then they found the bed of boulders upon which the cylinders were originally intended to rest. After this was a bed of red marl, beneath which they discovered solid rock, resembling what is known as milestone grit, into which the cylinders were sunk. The mode in which this part of the work was performed was